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FIELD EVALUATION OF EXPERIMENTAL CRASH-CREW FIREFIGHTER'S FACEP--ETC(U)
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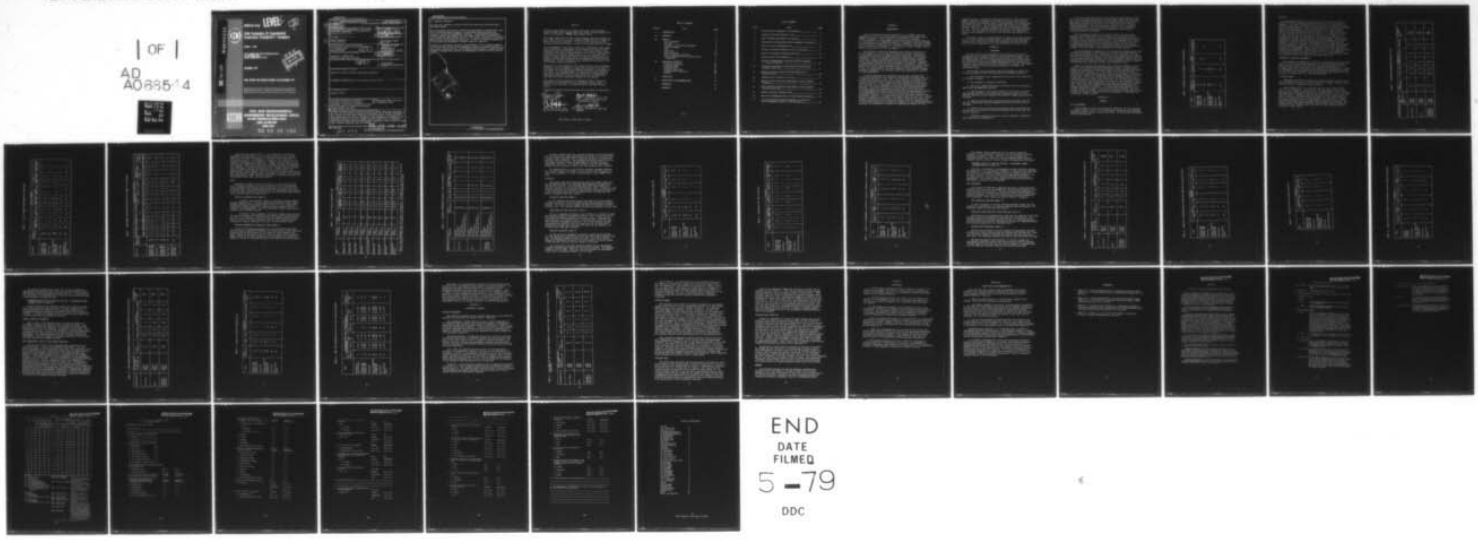

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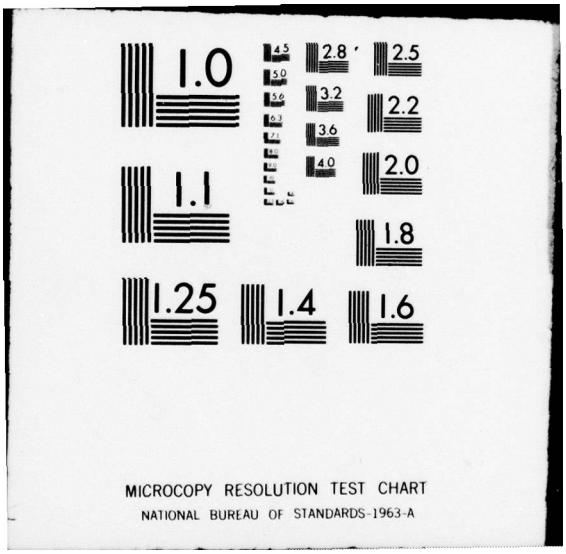
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Field Evaluation Of Experimental Crash-Crew Firefighter's Facepiece

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DECEMBER 1978

FINAL REPORT FOR PERIOD OCTOBER 1976-SEPTEMBER 1977

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CEEDO

CIVIL AND ENVIRONMENTAL ENGINEERING DEVELOPMENT OFFICE
(AIR FORCE ENGINEERING AND SERVICES CENTER)
TYNDALL AIR FORCE BASE
FLORIDA 32403

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Firefighter's Protective Clothing Field Test
Abcite Firefighter's Facepiece Overcoating
Coating Abrasion Resistance
Infrared Radiant Heat Protection
Heat Transmission Tests

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The Navy Clothing and Textile Research Facility (NCTRF) under the sponsorship of the Civil and Environmental Engineering Development Office (CEEDO), Detachment 1 ADTC, Tyndall Air Force Base, conducted a field evaluation of an Abcite-over-coated experimental crash-crew firefighter's gold facepiece to determine if the experimental facepiece was more durable than the standard item. Laboratory results had previously shown the experimental facepiece to have at least 10 times better abrasion resistance than the standard.

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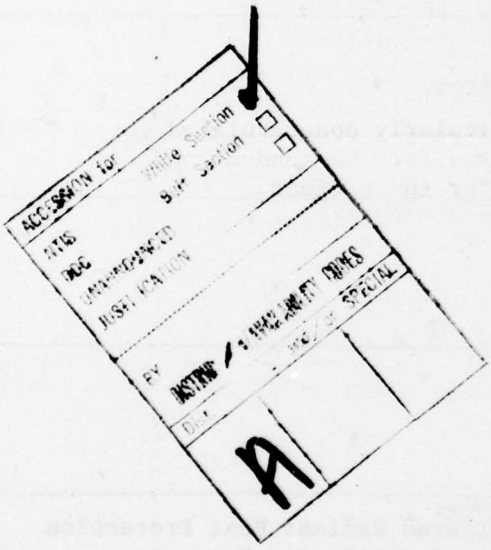
20. Abstract continued

The study was conducted at three Air Force and three Navy activities over a four-month period.

Most participants (56 percent) preferred the experimental facepiece and 77 percent of those principally engaged in firefighting operations during the evaluation favored the experimental facepiece. The experimental facepiece coatings appeared less damaged than the standard under those conditions which exist during firefighting operations, but were equally susceptible to mechanical damage during routine handling operations. In fact the standard facepiece did not outperform the experimental facepiece under any condition.

Although the experimental facepiece proved superior to the standard facepiece in the field test, it should not immediately replace the standard because it is more costly, proprietary, and can be damaged during handling. Cheaper and more available coatings which approach the performance of Abcite should be investigated.



PREFACE

This report was prepared by the Navy Clothing and Textile Research Facility (NCTRF) under Contract AFCEC P.O. 77-02, Job Order Number 414N-30-06, for Detachment 1 (CEEDO) ADTC, Tyndall AFB FL.

This report summarizes work done between October 1976 and September 1977. Mr C. Zemme was the lead project manager at NCTRF and Mr N. F. Audet of NCTRF was the project engineer. Air Force project managers (during successive periods) were Major B. Pease, Mr N. Knowles, and Mr. L. Redman.

The accomplishment of this task required the cooperation of many people which is gratefully acknowledged. The following individuals and their organizations are specifically mentioned: Fire Chiefs Johnson, Young, and Price of NAS Oceana, Virginia Beach VA; Cecil Field, Jacksonville FL; and Mirimar, San Diego CA, respectively; Major Gott, Director, Fire-fighter's School, Chanute AFB, Rantoul IL, and Fire Chiefs Millian and Goodwin of Eielson AFB, Fairbanks AK, and Tyndall AFB, Panama City FL, respectively. Without the help of these individuals this project could not have been properly accomplished.

Appreciation is also expressed to the activities that these individuals represent. Their willingness to allow their facilities to be used for the purposes of this work was of paramount importance to the conduct of this study. The individual members of these activities who directly took part as test volunteers are to be particularly congratulated for their general adherence to the procedure setup for the conduct and reporting of the data information required for the project.

This report has been reviewed by the Information Office (IO) and is releasable to the National Technical Information Service (NTIS). At NTIS it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

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SECTION I

INTRODUCTION

The Navy Clothing and Textile Research Facility (NCTRF), under the sponsorship of the Civil and Environmental Engineering Development Office (CEEDO), Detachment 1, ADTC, Tyndall Air Force Base FL, conducted a field evaluation on an experimental gold-coated facepiece being considered as a replacement for the standard facepiece, a component in the visor assembly of the crash-crew firefighter's hood, because the standard facepiece coatings have poor durability (Reference 1). The facepiece coatings provide infrared radiant heat protection to the firefighter.

The difference between the experimental and standard facepieces was the application of a 4-to-5-micron-thick Abcite protective overcoating to the standard facepiece to improve abrasion protection. Previous work (References 2 and 3) had identified Abcite as being superior in abrasion resistance to other overcoatings investigated, having suitable infrared radiant heat transmission characteristics, and having suitable resistance to environmental conditions to which firefighters are exposed. Standard facepieces overcoated with Abcite had abrasion resistances at least 10 times greater than than of similar facepieces with no overcoating (Reference 3). It was to be established by the field evaluation if this improved abrasion resistance indicated by the laboratory results was significant in relation to field requirements.

The field evaluation was conducted at six activities (Chanute AFB, Eielson AFB, Tyndall AFB, Cecil Field NAS, Mirimar NAS, and Oceana NAS) over a 4-month period (April to July 1977). The evaluation was limited to the duration indicated because of time constraints imposed by the sponsor to accomplish the task. Field response from participating activities showed that a majority of all respondents (56 percent) preferred the experimental facepiece. The results from the Air Force activities demonstrated that 70 percent favored the experimental facepiece and at two of the three participating Navy Activities 57 percent preferred the experimental facepiece. At the remaining Navy activity (Oceana NAS) only 25 percent favored the experimental facepiece. At one activity, Chanute AFB, where personnel were principally exposed to fire conditions during the evaluation period, 77 percent favored the experimental facepiece. The results indicated that, under fire-fighting conditions in which considerable damage occurs to the gold coating on the standard facepiece in clearing the facepiece of fire-extinguishing-agent-materials, the experimental facepiece was significantly superior to the

standard facepiece. Under normal handling conditions in which mechanical damage (scratches and gouges) to the facepiece coatings occurs from impacting against hard and sharp objects, the experimental and standard facepiece were equivalent. The one failure mode experienced by the standard facepiece that was not normally indicated for the experimental facepiece was wear. There is a general wearing of the gold on the standard facepiece as a result of usage whereas the Abcite overcoating on the experimental facepiece limits damage to only those areas that have been impacted by an object.

This report covers the method employed to field evaluate the facepiece, and the results obtained from questionnaire information and radiant heat exposure tests conducted on field tested facepieces that were returned. Conclusions and recommendations are also established from these results.

SECTION II

PROCEDURE

The six activities participating in the evaluation were given 30 experimental and 30 standard facepieces and 30 information packets. Each information packet included one set of instructions, 10 log sheets, and one questionnaire form. At the beginning of the evaluation, each activity was visited and the personnel assigned responsibility for conducting the evaluation were oriented on how the evaluation was to proceed. The appendix contains a sample of the instructional information, log sheet, and questionnaire form.

The log sheet and questionnaire forms were designed to provide the following information about the experimental and standard facepieces.

1. The influence of duty assignments and use time on the condition of the facepiece coatings.

2. The frequency of facepiece replacement.

3. The type of damage inflicted on the facepiece and the conditions under which the damage was sustained.

4. The influence of care on the lifetime of the facepiece coatings. Care included the effects of cleaning dirty facepieces after use, and physical protection of the facepiece from mechanical damage during periods of nonuse.

5. Whether visibility was suitable both when the facepiece was new and used, and whether visibility degraded more rapidly with one type of facepiece.

6. Whether heat protection was suitable both when the facepiece was new and used, and whether heat protection degraded more rapidly with one type of facepiece.

7. Facepiece preference based upon overall performance (visibility, heat protection, and durability).

Of the six activities selected to participate in the evaluation, three were Air Force (Chanute AFB, Eielson AFB, and Tyndall AFB), and three were Navy (Cecil Field NAS, Mirimar NAS, and Oceana NAS). NCTRF selected Chanute AFB because it houses the Air Force's fire school where the facepieces would be subjected to fire conditions more frequently than at a regular operational Activity. The other activities had very active operational fire stations and represented different geographical areas--Florida, Virginia, California and Alaska.

Test procedures followed at each activity varied. At some, equal numbers of participants were given a standard and experimental facepiece initially for a fixed period of time and then these facepieces were replaced with each person receiving a different type for the remainder of the study. At others, all were initially given the same facepiece type and then after a selected time interval all were issued another type. At one activity, (Mirimar NAS) where hoods are not individually assigned but are strategically located on the fire trucks, several people wore the same facepiece.

Not all firefighters taking part in the evaluation followed instructional guidelines particularly in filling out the log sheet forms with regard to use time and frequency of use. Consequently, it was impossible to correlate the effect of time and frequency of use to preference and facepiece condition for all tested facepieces. However, for those firefighters who used both the experimental and the standard facepiece a time comparison of their preference could be made since they used the same time reference for both.

Many of the field-tested facepieces were returned to NCTRF at the conclusion of the evaluation and were subsequently tested to establish their radiant heat protection characteristics which were then compared with results obtained on new facepieces. For each facepiece the section tested was a 4-inch-wide by 2-inch-high area in the center of the facepiece. Because the same area was tested on all facepieces, the most damaged area was not tested in each case. The center area was selected for the tests because it was considered the most critical. During the tests, each facepiece was backed by a 1/4-inch-thick clear polycarbonate sheet material, thus providing a visor thermal protection system equivalent to that used in the crash-crew firemen's hood. These tests were conducted with the quartz-lamp radiant-heat test apparatus described in Reference 2. The test samples were subjected to an incident radiant heat pulse of 1.9 gcal/cm^2/sec for 30 seconds. The lamp preheat time was 60 seconds. The heat flux transducer for measuring the heat transmitted through the samples was located approximately 0.5cm behind the polycarbonate backup material.

SECTION III

RESULTS

DUTY ASSIGNMENTS

The principal duties of the firefighters taking part in this evaluation are given in Table 1. For all activities except Chanute AFB, the principal duties were either standby or patrol operations. At Chanute AFB firefighting was the principal duty.

TABLE 1. PRINCIPAL DUTY ASSIGNMENT OF FIREFIGHTERS

Base	Number of Respondents	Duty		
		Standby	Patrol	Firefighting
Chanute AFB	13			13
Eielson AFB	4	4		
Tyndall AFB	33	7	26	
AFB Total	50	11	26	13
Cecil Field NAS	29	29		
Mirimar NAS	19	19		
Oceana NAS	27	27		
NAS Total	75	75		
AFB and NAS Total	125	86	26	13

USE TIME

As explained previously, it was difficult to correlate use time with respect to facepiece preference because of the nature of the field-test responses. For those respondents who wore both type of facepieces and indicated a use-time measure, a simple, expedient approach to correlate preference with use time was employed. Use time was expressed in relative terms between the experimental and standard facepieces (less, same, and more). Table 2 gives the combined Air Force and Navy values as well as the totals for each relating use time to facepiece preference. For those few cases in which the use time was identical the high percentage preferring the experimental facepiece in that category is not significant. The preference reflected for the experimental facepiece by other respondents were similar regardless of whether they wore the experimental less or more than the standard. There was no apparent relationship between use time and preference for the experimental facepiece. Two thirds of these Air Force respondents preferred the experimental whereas only one third of the Navy respondents preferred the experimental. Approximately 50 percent of all these respondents preferred the experimental facepiece while 38 percent of the remaining indicated that either was equally satisfactory. Less than 8 percent thought the standard facepiece was better than the experimental one.

FREQUENCY OF FACEPIECE REPLACEMENT

No information on frequency of facepiece replacement could be established because of the test procedures employed by the various activities and the short evaluation period. Most activities replaced facepieces after an arbitrary time period rather than by the condition of the facepiece. In fact, an investigation of most facepieces returned to NCTRF indicated that, except for the Chanute AFB facepieces, both the standard and experimental types were not worn to a degree where they required replacement.

FACEPIECE DAMAGE

Respondents were asked to indicate the kinds of damage the two facepiece types experienced and what use conditions caused the damage. Tables 3 and 4 show the results of responses to these questions.

Type of Damage (Table 3) - Scratches were the type of damage listed most for both facepieces. Scratches were indicated about 19 percent more often for the standard facepieces than for the experimental. Other frequently expressed types of damage for the standard facepiece were marring, wear, and poor visibility. Respondents indicated marring 72 percent, wear 40 percent, and poor visibility 230 percent more frequently for the standard facepiece as a type of damage than for the experimental. The other types of damage mentioned were gouges in the coatings and blistering of the coatings. These types of damage were seldom cited (less than 10 percent of all responses). Blistering of the coatings occurred similarly for both facepiece types as a result of flame contact.

TABLE 2. FACEPIECE PREFERENCE RELATED TO USE

Organization	Use Time EXP Relative to STD	Total Respondents	Preference					Preference for EXP (%)
			EXP	STD	Either	Neither	Unknown	
Air Force	Less	11	8	0	3	0	0	73
	Same	1	1	0	0	0	0	100
	More	19	13	1	4	0	1	68
Navy	Less	18	6	1	11	0	0	33
	Same	2	2	0	0	0	0	100
	More	16	6	3	6	1	0	37
Combined Air Force and Navy	Less	29	14	1	14	0	0	48
	Same	3	3	0	0	0	0	100
	More	35	19	4	10	1	1	54

TABLE 3. TYPE OF DAMAGE EXPERIENCED BY FACEPIECES

Activity	Number of Responses	Type of Damage											
		Marring		Wear		Scratches		Gouges		Poor Visibility		Blistering	
		EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD
Chanute AFB	49	4	7	2	6	8	7	1	3	1	6	2	2
Eielson AFB	11	1				3	2	0	2	1	2		
Tyndall AFB	44	2	4	3	6	9	14	1	4	0	1		
AFB Total	104	7	11	5	12	20	23	2	9	2	9	2	2
Cecil Field NAS	68	3	8	1	7	16	24			2	7		
Mirimar NAS	30	3	5	0	2	5	8	1	2	1	3		
Oceana NAS	77	5	7	3	10	20	18	6	2	2	4		
Navy Total	175	11	20	4	19	41	50	7	4	5	14		
Combined Air Force and Navy Total	279	18	31	9	31	61	73	9	13	7	23	2	2

TABLE 4. OPERATIONAL CONDITIONS WHICH INFLICT DAMAGE TO FACEPIECES

Activity	Number of Responses	Operational Conditions																			
		Handling		Storage		Wiping		Cleaning		Replacement		Exposure to									
												Water		AFFF		Hydro-Carbon		Heat		Flame Contact	
		EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD
Chanute AFB	47	3	6	1	2	2	7	1	4			2	2	0	5	1	1	0	3	2	5
Eielson AFB	16	3	3	3	3				1	1	2										
Tyndall AFB	30	7	11	2	2	1	1					1	1	1	1			1	1		
AFB Total	93	13	20	6	7	3	8	1	5	1	2	3	3	1	6	1	1	1	4	2	5
C.Field NAS	2	1	1																		
Mirimar NAS	22	4	5	1	2	2	3					2	1	0	1					1	0
Oceana NAS	64	11	12	9	9	3	5	2	1	1	2	1	3	1	3			1	0		
Navy Total	88	16	18	10	11	5	8	2	1	1	2	3	4	1	4			1		1	
Combined Air Force and Navy Total	181	29	38	16	18	8	16	3	6	2	4	6	7	2	10	1	1	2	4	3	5

Operational Conditions (Table 4) - The operational condition most indicated as causing damage to the coatings of both facepiece types was handling of the item (37 percent of all responses and was indicated 30 percent more often for the standard). Storage was the second most cited condition (19 percent of all responses). Damage to the coatings was also indicated from mechanical actions such as wiping, cleaning, and replacing the facepiece. Under these conditions the standard facepiece was mentioned more frequently as having sustained this type of damage (100 percent more often for wiping, cleaning, and replacing the standard than for the experimental). Both facepiece types were thought to be equally affected by water and hydrocarbon exposure whereas the standard facepiece was considered more susceptible to damage than the experimental to exposure to Aqueous Film Forming Foam (AFFF), heat, and flame contact.

CARE

Questions were asked of the participants as to what effect cleaning of the facepiece coatings after use and protection of the coatings from direct mechanical abuse during nonuse periods had on the life of the two facepiece types. The facepiece preference of the participants with respect to the care they provided the facepieces was also established from responses. These results are given in Tables 5 and 6.

EFFECT OF FACEPIECE LIFE (TABLE 5)

Cleaning - No substantial number of respondents thought cleaning increased facepiece life. For the experimental facepiece an equal number thought cleaning either increased or had no effect on life. Fewer people (28 percent) thought cleaning the standard facepiece increased life as compared to the experimental. Very few respondents thought cleaning either facepiece type decreased its life.

Protection - Most respondents (70 percent) thought protecting the two types of facepiece from mechanical abuse during nonuse periods improved the life of the facepiece. Less than 10 percent thought protection had no effect on the life of either facepiece type, and none indicated that protection had a negative influence on the life of both facepiece types.

FACEPIECE PREFERENCE AS RELATED TO CARE (TABLE 6)

For Air Force personnel, preference for the experimental was greater than 70 percent, regardless of whether or not they cared for their facepieces. Preference did not seem related to care except for those personnel who either cleaned and protected or did not clean and protect their facepieces. Eighty percent of those who provided total care preferred the experimental whereas 71 percent of those who provided no care preferred the experimental.

TABLE 5. EFFECT OF CARE ON FACEPIECE LIFE

Base	Care of Facepiece	Total Respondents*	Effect on Life							
			Increase		None		Decrease		Unknown	
			STD	EXP	STD	EXP	STD	EXP	STD	EXP
Chanute AFB	Clean	13	3	8	1	3	4	0	1	1
	Protected	13	9	14	0	1	0	0	0	0
Eielson AFB	Clean	3	2	2	1	1	0	0	0	0
	Protected	2	1	1	0	0	0	0	0	0
Tyndall AFB	Clean	7	2	2	5	4	0	0	0	0
	Protected	4	3	3	1	0	0	0	0	0
AFB Total	Clean	23	7	12	7	8	4	0	1	1
	Protected	19	13	17	1	1	0	0	0	0
Cecil Field NAS	Clean	18	5	7	10	10	0	0	3	1
	Protected	18	13	13	2	2	0	0	0	0
Mirimar NAS	Clean	15	4	4	7	6	2	2	0	0
	Protected	14	10	11	1	1	0	0	0	0
Oceana NAS	Clean	21	4	5	4	4	2	3	1	1
	Protected	19	14	14	1	2	0	0	1	1
NAS Total	Clean	54	13	16	21	20	4	5	4	2
	Protected	51	37	38	4	5	0	0	1	1
AFB and NAS Totals	Clean	77	20	28	28	28	8	5	5	3
	Protected	70	50	55	5	6	0	0	1	1

* Some of the respondents wore both types of facepieces. Consequently, the figures in the effect on life section of the table are greater than those in the Total Respondents column.

TABLE 6. FACEPIECE PREFERENCE RELATED TO CARE OF FACEPIECES

Organization	Care of Facepiece	Total Respondents	Preference					Preference for EXP (%)
			EXP	STD	Either	Neither	Unknown	
Air Force	Cleaned	21	16	1	4	0	0	76
	Not Cleaned	13	10	0	2	0	1	77
	Protected	18	14	1	3	0	0	78
	Not Protected	16	12	0	4	0	0	75
	Cleaned and Protected	15	12	1	2	0	0	80
	Not Cleaned and Protected	14	10	0	3	0	1	71
Navy	Cleaned	52	23	6	21	1	1	44
	Not Cleaned	12	5	1	6	0	0	42
	Protected	46	19	5	20	1	1	41
	Not Protected	17	9	1	7	0	0	53
	Cleaned and Protected	42	17	5	19	1	0	40
	Not Cleaned and Protected	17	9	1	7	0	0	53
Combined Air Force and Navy	Cleaned	73	39	7	25	1	1	53
	Not Cleaned	25	15	1	8	0	1	60
	Protected	64	33	6	23	1	1	52
	Not Protected	33	21	1	11	0	0	64
	Cleaned and Protected	57	29	6	21	1	0	51
	Not Cleaned and Protected	31	19	1	10	0	1	61

For Navy personnel there was a greater preference for the experimental type (29 percent more) among those who did not protect, and did not clean or protect their facepieces than for those who protected, or cleaned and protected, their facepieces. Navy personnel who either cleaned or did not clean their facepieces showed the same degree of preference for the experimental facepiece. The greatest preference for the experimental facepiece by Navy personnel in any of the care catagories was 53 percent.

The combined opinion of both Air Force and Navy personnel indicated that a greater number of those who did not care for their facepieces preferred the experimental (at least 13 percent more) to the standard facepiece.

VISIBILITY

Participants were asked their opinions about the overall quality of the visibility provided by the standard and experimental facepieces both when new and after use. They were also asked their opinion about the relative visibility of both new and used facepiece types. In addition, their facepiece preference was compared to their opinions relating the visibility of the experimental facepiece to the standard after both had been used. Tables 7 through 10 show these results.

VISIBILITY WHEN NEW (TABLE 7)

Of all responses, 90 percent thought the visibility of the standard facepiece new was good while 95 percent thought the experimental facepiece was good. Less than 2 percent thought the visibility was poor for either facepiece type. The remainder thought visibility was marginal for both types.

CONDITIONS FOR POOR VISIBILITY (TABLE 8)

Of the 35 responses pertaining to poor visibility, 77 percent of these were expressed against the standard facepiece. Most of these (63 percent) concerning the standard facepiece were related to use in nighttime and dusk conditions. The remainder were: 7 percent daytime, 15 percent dawn, and 15 percent fire-exposure conditions. Of the few responses obtained concerning those conditions when the visibility with the experimental facepiece was thought poor, 25 percent were dusk and fire exposure, and 50 percent were nighttime conditions.

RELATIVE VISIBILITY (TABLE 9)

For the Air Force respondents, 43 percent thought their visibility with the experimental facepiece was better than the standard facepiece when new. The remainder thought they were the same. After use 67 percent thought the experimental was better than the standard, 30 percent thought it was the same, and only 3 percent thought it was worse.

Only 34 percent of the Navy personnel thought the new experimental facepiece provided better visibility than the new standard. The remainder thought it was the same. After use, 36 percent thought the experimental better while the remainder thought it was the same.

TABLE 7. QUALITY OF FACEPIECE VISIBILITY WHEN NEW

Base	Quality					
	Good		Marginal		Poor	
	EXP	STD	EXP	STD	EXP	STD
Chanute AFB	14	9	0	0	0	0
Eielson AFB	4	4	0	0	0	0
Tyndall AFB	20	17	1	3	0	0
AFB Total	38	30	1	3	0	0
Cecil Field NAS	25	25	0	0	0	0
Mirimar NAS	16	14	2	2	0	0
Oceana NAS	22	17	1	4	1	1
NAS Total	63	56	3	6	1	1
AFB and NAS Total	101	86	4	9	1	1

TABLE 8. CONDITIONS FOR POOR VISIBILITY

Base	Condition									
	Daytime		Nighttime		Dawn		Dusk		Fire Exposure	
	EXP	STD	EXP	STD	EXP	STD	EXP	STD	EXP	STD
Chanute AFB	0	0	0	0	1	1	0	0	0	0
Eielson AFB	0	0	2	2	0	0	0	0	0	0
Tyndall AFB	0	2	2	5	0	2	1	4	0	0
AFB Total	0	2	4	7	1	3	1	4	0	0
Cecil Field NAS	0	0	0	0	0	0	0	1	0	0
Mirimar NAS	0	0	1	2	0	0	0	1	0	0
Oceana NAS	0	0	1	2	0	2	1	2	1	2
NAS Total	0	0	2	4	0	2	1	4	1	2
AFB and NAS Total	0	2	6	11	1	5	2	8	1	2

TABLE 9. QUALITY OF EXPERIMENTAL FACEPIECE VISIBILITY COMPARED TO STANDARD FACEPIECE

Base	Condition					
	New			Used		
	Better	Same	Poorer	Better	Same	Poorer
Chanute AFB	6	7	0	9	3	0
Eielson AFB	3	1	0	4	0	0
Tyndall AFB	7	13	0	11	8	1
AFB Total	16	21	0	24	11	1
Cecil Field NAS	8	13	0	9	12	0
Mirimar NAS	8	9	0	8	7	0
Oceana NAS	5	18	0	4	18	0
NAS Total	21	40	0	21	37	0
AFB and NAS Total	37	61	0	45	48	1

The combined results showed that only 37 percent thought the visibility of the experimental was better than the standard new and the remainder considered it equal. After use, 45 percent thought the experimental gave better visibility than the standard while 48 percent thought it was the same and 1 percent thought the experimental was poorer.

PREFERENCE BASED ON VISIBILITY OPINIONS - EXPERIMENTAL VERSUS STANDARD AFTER USE (TABLE 10)

There was a high degree of correspondence between visibility opinions and preference for the experimental facepiece. Of those Air Force personnel who thought the experimental facepiece had better visibility than the standard after use, 87 percent preferred the experimental facepiece. For this same condition, 100 percent of the Navy personnel preferred the experimental. The combined results showed that 94 percent preferred the experimental facepiece for this condition.

HEAT PROTECTION

The opinions of respondents regarding the quality of heat protection provided by the facepieces was assessed for those personnel exposed to fire conditions during the evaluation. Data were obtained concerning new and used facepieces and conditions under which heat protection was thought poor. Facepiece preference as related to perceived heat protection quality was also established. These results are given in Tables 11 through 14.

HEAT PROTECTION WHEN NEW (TABLE 11)

At least 89 percent of Air Force and Navy personnel thought the heat protection of experimental and standard facepieces when new was good. The remainder thought the protection was marginal.

CONDITIONS UNDER WHICH HEAT PROTECTION POOR (TABLE 12)

There were only six responses which indicated the conditions under which the heat protection provided by the facepiece was considered poor. One response indicated the standard facepiece was poor in providing radiation protection while two stated the experimental and three the standard provided poor protection against hot air (convective heat).

RELATIVE HEAT PROTECTION (TABLE 13)

For Air Force personnel 41 percent thought the experimental facepiece provided better heat protection than the standard when both were new. After use, 55 percent thought the experimental facepiece provided better heat protection. The remaining responses indicated the heat protection was equal.

The same percentage of Navy personnel (41 percent) thought the experimental facepiece provided better heat protection than the standard facepiece when both were new, but this opinion dropped to 20 percent after use. The remaining responses indicated heat protection was equal.

TABLE 10. VISIBILITY PREFERENCE OF EXPERIMENTAL VERSUS STANDARD FACEPIECE AFTER USE

Organization	Visibility of Used EXP Versus Used STD	Total Respondents	Preference					Preference for EXP (%)
			EXP	STD	Either	Neither	Unknown	
Air Force	Better	24	21	1	2	0	0	87
	Same	8	3	0	5	0	0	38
	Poorer	1	1	0	0	0	0	100
Navy	Better	22	22	0	0	0	0	100
	Same	39	6	6	25	2	0	15
	Poorer	0	0	0	0	0	0	-
Combined Air Force and Navy	Better	46	43	1	2	0	0	94
	Same	47	9	6	30	2	0	19
	Poorer	1	1	0	0	0	0	100

TABLE 11. QUALITY OF FACEPIECE HEAT PROTECTION WHEN NEW FOR EXPOSED PEOPLE

Base	Quality					
	Good		Marginal		Poor	
	EXP	STD	EXP	STD	EXP	STD
Chanute AFB	14	9	0	0	0	0
Eielson AFB	2	1	0	0	0	0
Tyndall AFB	6	6	0	2	0	0
AFB Total	22	16	0	2	0	0
Cecil Field NAS	25	24	0	0	0	0
Mirimar NAS	3	3	1	2	0	0
Oceana NAS	6	6	0	0	0	0
NAS Total	34	33	1	2	0	0
AFB and NAS Total	56	49	1	4	0	0

TABLE 12. CONDITIONS FOR POOR HEAT PROTECTION

Base	Condition			
	Radiation		Hot Air	
	EXP	STD	EXP	STD
Chanute AFB	0	0	0	0
Eielson AFB	0	0	0	0
Tyndall AFB	0	1	0	1
AFB Total	0	1	0	1
Cecil Field NAS	0	0	0	0
Mirimar NAS	0	0	0	0
Oceana NAS	0	0	2	2
NAS Total	0	0	2	2
AFB and NAS Total	0	1	2	3

TABLE 13. QUALITY OF HEAT PROTECTION--EXPERIMENTAL VERSUS STANDARD FACEPIECE

Base	Condition					
	New			Used		
	Better	Same	Poorer	Better	Same	Poorer
Chanute	6	7	0	8	3	0
Eielson	1	1	0	1	1	0
Tyndall	2	5	0	2	5	0
AFB Total	9	13	0	11	9	0
Cecil Field NAS	12	13	0	6	19	0
Mirimar NAS	2	2	0	0	3	0
Oceana NAS	1	6	0	1	6	0
NAS Total	15	21	0	7	28	0
AFB and NAS Total	24	34	0	18	37	0

The combined responses showed again that 41 percent thought the experimental provided better heat protection than the standard facepiece when new while 32 percent thought it better after use. In both new and used conditions, the remaining opinions indicated the protection provided by both facepiece types was the same.

PREFERENCE BASED ON HEAT PROTECTION OPINIONS - EXPERIMENTAL VERSUS STANDARD AFTER USE (TABLE 14)

As with visibility the correlation between heat protection opinion and facepiece preference was significant. Of those combined Air Force and Navy personnel who thought the heat protection provided by the experimental facepiece was better, 89 percent preferred the experimental facepiece. For those who thought the heat protection was the same, only 44 percent preferred the experimental facepiece.

OVERALL FACEPIECE PREFERENCE

Based on their total experience with the facepieces during the evaluation, personnel were asked for their facepiece preference. They were asked to consider the visibility, heat protection, and durability characteristics of the two facepieces in expressing their opinion. Table 15 shows these results. For Air Force personnel, 72 percent preferred the experimental while only 48 percent of the Navy personnel preferred the experimental. The combined results show that 56 percent preferred the experimental, 32 percent thought the facepieces equivalent, and less than 6 percent preferred the standard facepiece.

HEAT TRANSMISSION TESTS ON FIELD TESTED FACEPIECES

Table 16 gives the heat flux transmission data measured on field tested facepieces. A total of 195 facepieces were tested. The only appreciable change in heat transmission values from a new condition occurred on the standard facepieces returned from Chanute AFB and Mirimar NAS (11 times and 4 times greater, respectively). The maximum average change measured on other facepieces was only about 30 percent for the standard facepiece. The maximum increase in heat transmission for the experimental facepiece was only 6 percent. The only statistically significant difference between the means of the heat transmission data of the standard and experimental at any activity occurred for Chanute AFB. The probability that the differences measured on the Chanute AFB facepieces were due to chance alone was less than 0.1 percent. The differences in the average heat transmission values for the Mirimar NAS standard and experimental facepieces were 0.32 versus 0.029 gcal/cm^2/sec, respectively. Although this numerical difference was great, these data had a probability of only 10 percent that the differences measured were due to chance alone, because the variability in the data for the standard facepiece was great.

TABLE 14. HEAT PROTECTION PREFERENCE--EXPERIMENTAL VERSUS STANDARD FACEPIECE AFTER USE

Organization	Heat Protection of Used EXP versus Used STD	Total Respondents	Preference					Preference for EXP (%)
			EXP	STD	Either	Neither	Unknown	
Air Force	Better	12	10	1	1	0	0	83
	Same	7	4	1	2	0	0	57
	Poorer	0	0	0	0	0	0	-
Navy	Better	7	7	0	0	0	0	100
	Same	29	12	5	12	0	0	41
	Poorer	0	0	0	0	0	0	-
Combined Air Force and Navy	Better	19	17	1	1	0	0	89
	Same	36	16	6	14	0	0	44
	Poorer	0	0	0	0	0	0	-

TABLE 15. OVERALL FACEPIECE PREFERENCE DATA

Base	Total Respondents	Preference					Preference for EXP (%)
		EXP	STD	Either	Neither	Unknown	
Chanute AFB	13	10	0	2	1	0	77
Eielson AFB	4	3	0	1	0	0	75
Tyndall AFB	19	13	0	4	0	2	68
AFB Total	36	26	0	7	1	2	72
Cecil Field NAS	25	14	4	7	0	0	56
Mirimar NAS	16	10	0	5	1	0	62
Oceana NAS	24	7	2	14	1	0	29
NAS Total	65	31	6	26	2	0	48
AFB and NAS Total	101	57	6	33	3	2	56

TABLE 16. HEAT FLUX TRANSMISSION DATA FOR FIELD TESTED FACEPIECES

Base	Transmitted Heat Flux (gcal/cm^2/sec)						Level of Significance of Means (%)
	STD FACEPIECE			EXP FACEPIECE			
	No. Samples	Mean	STD Dev.	No. Samples	Mean	STD Dev.	
Contractor Received Mat.	3	0.031	± .001	3	0.032	± 0.003	< 70
Chanute AFB	9	0.350	± .270	14	0.031	± 0.003	< 0.1
Eielson AFB	1	0.026		7	0.033	± 0.002	-
Tyndall AFB	20	0.041	± .015	21	0.034	± 0.007	< 10
AFB Total	30	0.141	± .202	42	0.033	± 0.005	< 1
Cecil Field NAS	23	0.037	± .008	20	0.033	± 0.011	< 20
Mirimar NAS	15	0.132	± .178	10	0.029	± 0.006	< 10
Oceana NAS	27	0.037	± .019	28	0.032	± 0.006	< 20
NAS Total	65	0.059	± .086	58	0.032	± 0.008	< 5
AFB and NAS Total	95	0.085	± .134	100	0.032	± 0.007	< 1

Preference for the experimental facepiece was also correlated where possible to heat transmission values measured on returned facepieces. The correlation was simply based upon whether the transmission of the experimental facepiece was less, same, or more than the standard. Table 17 shows a relatively high correlation among Air Force personel between preference for the experimental facepiece and its heat transmission value. There was a slightly inverse correlation in these results for Navy personnel. The combined service results showed that the majority (59 percent) of those personnel whose facepieces showed less heat transmission for the experimental than for the standard facepiece preferred the experimental.

SECTION IV

DISCUSSION OF RESULTS

FACEPIECE PREFERENCE

The preference expressed by the personnel taking part in the evaluation appeared to be influenced by several factors. They were:

Duty Assignments - Chanute AFB was the only activity taking part in the evaluation whose personnel were principally engaged in firefighting operations and they had the greatest number of respondents (77 percent) preferring the experimental facepiece. At the other activities, where standby and patrol operations were the norm and which returned a representative number of responses, preference for the experimental facepiece ranged from 29 to 68 percent (Table 15).

Operational Methods - Mirimar NAS was the only activity in the study that did not assign hoods to individual firemen, but placed them strategically on the fire trucks for use by a number of different personnel. At Mirimar 62 percent preferred the experimental facepiece which was higher than the other Navy activities where principal duties also involved standby and patrol operations.

Care - When the combined preference results for the experimental facepiece are considered in relation to the type of care received by the facepieces, (Table 6), those personnel who did not care for the facepieces showed a greater preference for the experimental facepiece. Thus, it would appear that when the facepieces were not cared for damage was accelerated, thus providing respondents with a greater relative change in the condition of both facepiece types upon which to state an opinion.

Visibility - Results relating preference for the experimental facepiece to opinions as to which facepiece provided the best visibility correlated highly (Table 10). The combined results indicated that, of those who thought the experimental gave better visibility than the standard after use, 94 percent preferred the experimental facepiece.

TABLE 17. AIR FORCE AND NAVY FACEPIECE PREFERENCE AS RELATED TO HEAT TRANSMISSION VALUES OF USED FACEPIECES

Organization	Heat Transmission Value EXP Relative to STD	Total Respondents	Preference					Preference for EXP (%)
			EXP	STD	Either	Neither	Unknown	
Air Force	Less	18	13	1	4	0	0	72
	Same	0	0	0	0	0	0	-
	More	3	1	0	1	0	1	33
Navy	Less	19	9	1	9	0	0	47
	Same	5	0	2	3	0	0	0
	More	8	4	0	4	0	0	50
Combined Air Force and Navy	Less	37	22	2	13	0	0	59
	Same	5	0	2	3	0	0	0
	More	11	5	0	5	0	1	45

Heat Protection - As with visibility, those personnel (89 percent) who thought the experimental facepiece protected better against heat than the standard after use preferred the experimental facepiece (Table 14) to a high degree. There were also similar results, although not to the same degree, when heat transmission measurements were related to facepiece preference (Table 17). The combined results indicated that the majority of personnel (58 percent) whose experimental facepieces transmitted less heat than the standard preferred the experimental facepieces.

FACEPIECE DAMAGE

Both facepiece types seemed to be equally susceptible to scratching, gouging, and blistering, but the experimental appeared to be more durable against marring, wear, and poor visibility (Table 3). The conditions inflicting damage from handling, storage, and exposure to water were apparently equally effective against both facepieces, but the experimental was not influenced as much as the standard by wiping and cleaning actions, and exposure to AFFF (Table 4). The results would tend to indicate the experimental facepiece has better durability than the standard. The marring, wear, and poor visibility damage noted more frequently for the standard are the types of damage that the Abcite overcoating on the experimental facepiece would be expected to reduce. Scratching and gouging of either facepiece has not apparently been reduced substantially by the Abcite overcoating, although laboratory tests (Reference 3) indicated Abcite coated facepieces had superior scratch resistance to standard facepieces. The difference in field and laboratory results with regard to scratching would indicate that objects contacted by the facepiece in the field are substantially more abrasive than the cotton duck abradant used in the laboratory tests.

Other information regarding facepiece visibility (Table 9) and heat flux transmission tests (Table 17) also indicate that the experimental facepieces were not damaged as much as the standard facepieces in this study. In Table 9 the number of people who thought the visibility of the experimental facepiece was better increased from the new condition to the used condition. Moreover, heat flux transmission data indicated no significant change in heat protection provided by the experimental facepiece, whereas with many of the standard facepieces particularly those used at Chanute AFB and Mirimar NAS, where harsher conditions were experienced, heat transmission values increased by factors of 11 and 4, respectively.

FACEPIECE CARE

The results were conclusive that the provision of some means to protect the facepiece coating during periods of nonuse increases service life for either facepiece type (greater than 90 percent of respondents so indicated). The results were not as definitive for cleaning. Less than 50 percent thought cleaning increased the life of either facepiece (Table 5). The relatively good condition of most facepiece types received from the field excluding Chanute AFB and Mirimar NAS, as judged from their low heat flux transmission values (Table 16), were probably in part related to the care given the facepiece during the evaluation as well as the limited duration of the study and the type of operations conducted.

Most of the respondents thought the visibility of either type of facepiece was good (Table 7). The conditions under which they thought visibility was poor were principally at night or dusk (Table 7). Most personnel could not perceive a difference in visibility between either facepiece when new or used, although more thought the visibility of the experimental facepiece was better than the standard after use than when new (Table 9). This lack of difference, noted particularly in the new condition, was to be expected since the only difference in either facepiece was the application of the transparent Abcite overcoating. The fact that more thought the experimental facepiece had better visibility than the standard facepiece after use (20 percent increase) possibly indicates less damage occurred to the experimental facepieces from use than to the standard.

FACEPIECE HEAT PROTECTION

Nearly all respondents (97 percent or more) thought that the heat protection from either facepiece was good (Table 11) and in the few responses which indicated that heat protection was poor, all but one was related to convective heat protection (Table 12). The majority of the respondents did not think the heat protection provided by the experimental facepiece better than the standard (Table 13)--and it is not. Although the addition of the Abcite overcoating to the experimental facepiece does not affect the radiant heat transmitted through the facepiece, it does reduce the radiant heat resistance of the facepiece material because some of the radiant energy is absorbed by the coating instead of being reflected. However, the experimental facepiece still meets the radiant heat test criteria employed by NCTRF (1.9 gcal/cm^2/sec for 30 seconds) to judge these materials. These criteria were recommended by DOD Aircraft Ground Fire Suppression and Rescue Office (Reference 4).

Of particular interest was the reduction (25 percent) in personnel who thought the heat protection of the experimental facepiece better than the standard in the used rather than the new condition (Table 13). It may be that, because most personnel taking part in this evaluation had limited fire exposure during the study, they could not accurately perceive a difference in the heat protective quality. Heat flux transmission data on the field tested facepieces (Table 16) showed the experimental facepieces provided radiant heat protection that was essentially equal to or better than the standard facepieces received from all activities.

GENERAL

No correlation between use time and facepiece preference was discerned in the study (Table 2), probably because of the limited duration of the study and the manner in which the study was conducted at the various activities. Because of the short evaluation period, the frequency of facepiece replacement could not be established either.

SECTION V

CONCLUSIONS

1. From facepiece preference opinions, comments on facepiece care, visibility, and damage, and results of radiant heat flux transmission tests on field-tested facepieces, the experimental facepiece was proved superior to the standard facepiece.

2. The experimental facepiece was preferred by the majority (56 percent) of all respondents taking part in the study and especially by those who were primarily exposed to fire conditions during the study (77 percent).

3. Less damage was sustained by the experimental facepiece than the standard as reflected by comments related to marring, wear, and poor visibility. The experimental facepiece was considered by respondents to be equally susceptible to damage, such as scratching and gouging, caused in handling and storage as the standard facepiece.

4. Care can increase the lifetime of either facepiece type appreciably particularly if physical protection of the facepiece coatings is provided during nonuse periods. Whether cleaning of the coatings after use can increase life was not established, but from opinions expressed, cleaning did not reduce life.

5. Heat flux transmission data on the returned field-tested facepieces showed the heat protection provided by the experimental facepiece to be little affected as a result of use, whereas the heat protection provided by the standard facepiece types, especially those that were used principally in firefighting activities, degraded significantly.

6. The standard facepiece did not out perform the experimental facepiece under any of the factors in this study. In essentially all instances respondents either showed a clear preference for the experimental facepiece or they expressed an equivalent preference for both.

SECTION VI

FUTURE WORK AND RECOMMENDATIONS

Since the field test results showed the experimental facepiece superior to the standard facepiece, consideration must now be given to the problems associated with obtaining the experimental item for general field use. They are:

1. Abcite, a Dupont product, is currently only licensed to one company. Thus there are proprietary considerations.

2. The company licensed to use Abcite, although having the capability to both apply the vacuum-deposited gold film on the facepiece substrate as well as overcoat it with Abcite, has limited vacuum deposition production facilities and would in all likelihood have to procure the facepiece already gold coated from current suppliers and would just apply the Abcite overcoat. This procedure may affect the quality control that could be exercised over the finished facepiece.

3. The best price estimate obtained indicates that an Abcite overcoated facepiece in production quantities would cost three times as much as the current price of the standard. It is questionable whether the degree of superiority of the experimental warrants this additional expenditure.

Considering these problems, it is recommended that, although the experimental facepiece proved superior to the standard facepiece, a change to the experimental facepiece not be initiated presently. Instead, alternate overcoat materials should be sought which may approach Abcite in performance and be more generally available and economical.

It is further recommended that, because the experimental facepiece proved as susceptible to damage as the standard when unprotected during handling and storage during nonuse periods, the incorporation of an improved facepiece which will likely be more expensive than the standard presently in use not be initiated until the means of protecting the facepiece during nonuse periods be improved. The crash-crew firefighter's hood has been recognized as needing design improvements and one of these is the manner in which the facepiece is protected. Work is currently in progress related to hood improvements.

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3. Audet, N. F., Facepiece-Visor Assembly for Aluminized Firefighters' Crash-Rescue Protective Hood (Investigation of Abrasion-Resistant Overcoatings), NCTRF Technical Report No. 119, June 1976

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APPENDIX A

EVALUATION OF CRASH CREW FIREFIGHTER'S GOLD COATED FACEPIECE

The Navy Clothing and Textile Research Facility (NCTRF), Natick, MA has completed an investigation of transparent durable overcoatings on gold films to improve the abrasion resistance of the standard gold coated facepiece. The best of these coatings has been applied over the gold coating of the standard facepiece materials and designated as experimental to establish their use life under field conditions. Laboratory tests of this coating indicated that it provided an abrasion resistance at least 10 times better than achieved with the standard facepiece but it is unknown whether this degree of improvement is significant in relation to field requirements.

You are being asked to evaluate this experimental facepiece against the standard to determine whether it will last substantially longer than the standard in providing adequate facial radiant heat protection under field conditions.

To perform the evaluation we have provided each Activity with sufficient experimental and standard facepieces (30 each) to allow personnel to replace their facepieces as they become worn or damaged during the trial period (4 months). The Fire Chief at your Activity will maintain the spare facepieces and issue them to you when the one you are using is worn or damaged. Each facepiece has an identification code. A letter designation is located after the number (E or S) to identify whether it is an experimental (E) or standard (S) facepiece. You will turn in your used facepiece to the Chief for eventual return to NCTRF when you receive a new one. The Chief will insure that during the course of the study you use at least one standard and one experimental facepiece in order to enable you to compare the merits of each. You also are being provided by enclosure (1) with daily log sheets, questionnaire form which you will complete at the end of the study, and detailed instructions for maintaining the log forms and other reporting requirements.

It is important that you fill in your log sheet daily not only to aid you in the preparation of the questionnaire at the end of the study but to insure that NCTRF is provided with sufficient detailed information for accessing the qualities of the experimental facepiece with regard to the standard. Your complete cooperation in providing the data requested is necessary to insure the successful accomplishment of this evaluation.

The following additional information is provided to aid you in caring for the facepiece during non wear periods:

Cleaning Instructions - The facepiece should be cleaned after each use. The buildup of a dirtly abrasive grit on the facepiece or storing it wet will effect visibility and accelerate damage to the coatings. Cleaning should be done with a mild soap and water solution and a clean soft cloth. Liberally wet facepiece surface with cleaning solution and wipe surface with cloth previously soaked in solution using a gentle wiping action. Rinse surface with clean fresh water and pad surface dry with soft clean dry cloth.

Protection Instructions - To prevent physical damage to the coatings when the facepiece is being stored or handled, the facepiece cover supplied with the hood or similar covering should be placed over the facepiece.

INSTRUCTIONS FOR REPORTING

1. Daily Log Sheet - Form is to be filled out each day the FP is used or carried. Copies of these forms are to be sent to NCTRF on a monthly basis.

   a. Date Column - Enter date facepiece used or carried.

   b. FP ID No. Column - Enter FP ID No. located on gum paper label at edge of FP.

   c. Times Used or Carried

      Columns

      1) Freq. - Enter the number of times you used or carried the facepiece on the date listed.

      2) Period - Enter the total number of minutes you used or carried the facepiece on the date listed.

   d. Duties Performed Columns

      1) Type - List all the type duties performed on the dat listed using the duty codes provided at the bottom of the form. For instance, if you were on runway standby and carrying the facepiece you would enter code SC, if you performed rescue duties and used the facepiece you would enter code RU. If none of the duty codes listed applied you would enter code O and on the back of the form indicate the date, duty performed, and the time of performance in minutes. Enter no more than two duty codes in each row or use more than two rows for each date (total of 4 duty types). If more than 4 duty types performed on a given date place asterisk in this column block and enter information on the back of the form giving the date, duty codes, and time in minutes spent performing each duty.

      2) Period - For each duty code listed in the Type column block enter the time in minutes the duty was performed in this column block.

   e. Care of FP Columns

      1) Cleaned After use - If you cleaned FP check Yes column. If you did not clean it check No column. If FP cleaned enter cleaning method using the codes provided at the bottom of the form. If the Other "O" code is used enter on the back of the form the date and method used.

      2) Protected Prior to Storage or Handling - If you protected the FP check Yes column. If you did not protect it check No column. If FP protected enter protection method using the codes provided at the bottom of the form. If the Other "O" code is used enter on the back of the form the date and method used

   f. Condition of FP when Duty Began and Ended Columns - Enter the condition of the FP in the duty Began and Ended columns using the condition codes listed at the bottom of the form. For instance, if the FP is so badly scratched that visibility is clearly effected code Smaj should be used. If the Other "O" code is used enter on the back of the form the date and condition of the facepiece. WHEN ANY OF THE MAJOR CONDITIONS LISTED OCCUR THE FP SHOULD BE REPLACED.

g. Date FP Replaced Column - Enter the date FP replaced.

2. Questionnaire Form - Form is to be filled out at end of test (4 months) and submitted to NCTRF along with all daily log forms by each firefighter who took part in the study. Most of the questions are self explanatory. Where Other "0" type codes are indicated the necessary information is to be written on the back of the form preceded by the question number.

3. Failures - Unusal failures of any FP is to be reported through the Activity Fire Chief to NCTRF when they occur. Any injury to a firefighter that could be attributed to poor performance of the FP will also be reported to NCTRF when they occur.

4. Activity Evaluation - At the end of the test each Activity will complete the same questionnaire form filled out by the individual firefighters. This information will consolidate the views of all the firefighters and Fire Chiefs who took part in the evaluation at that Activity.

LOG OF FACEPIECE (FP) USEAGE

Date	FP ID No.	User ID	Times Used or Carried		Duties Performed		Care of FP						Condition of FP when duty (use code)		Date FP Replaced
							Cleaned after Use			Protected Prior to Storage or Handling					
			Freq.	Period (min.)	Type (use code)	Period (min.)	Yes	No	Method (use code)	Yes	No	Method (use code)	Began	Ended	

DUTY CODES:
- S - Runway Stand By
- P - Fire Patrol
- R - Rescue Operations
- FA - Fire Fighting Aircraft
- FS - Fire Fighting Structural
- FN - Fire Fighting Natural Cover
- O - Other (Explain on back of sheet)
- UorC - Wrtie in after duty code to indicate if FP used (U) or carried (C)

CARE CODES:

Cleaning Method
- R - As recommended
- O - Other (Explain on back of sheet)

Protection Method
- R - As recommended
- O - Other (Explain on back of sheet)

CONDITION OF FP CODES:
- Smin - Minor Scratches: No effect on visibility, or penetration of gold coating to clear layer.
- Smar - Marginal Scratches: Some perceptible effect on visibility, or a few slight penetrations of gold coating to clear layer.
- Smaj - Major Scratches: Visibility clearly effected, many penetrations of gold coating to clear layer, or gouges.
- Mmin - Minor Marring: No effect on visibility.
- Mmar - Marginal Marring: Some perceptible effect on visibility.
- Mmaj - Major Marring: Visibility clearly effected.
- Cmin - Minor Crazing: No effect on visibility.
- Cmar - Marginal Crazing: Some perceptible effect on visibility.
- Cmaj - Major Crazing: Visibility clearly effected.
- Wmin - Minor Wear: No noticeable change to the brightness of gold coating.
- Wmar - Marginal Wear: Slight dulling of brightness of gold coating, or a few small specks of gold removes.
- Wmaj - Major Wear: Readily noticeable change in brightness of gold coating, large number of small specks of gold removed, a few large spots where gold removed, or significant area which is void of gold (10% or more).
- O - Other (Explain on back of sheet)

NAVY CLOTHING AND TEXTILE RESEARCH FACILITY
Natick, MA 01760

Questionnaire for: Gold Coated Facepiece

1. Name of Evaluator: _____

2. Job Title: _____

3. Identification Numbers of Facepieces Used?

   a) Standard _____

   b) Experimental _____

4. Duties performed? (Check all that apply)

   a) Runway Stand By _____

   b) Fire Patrol _____

   c) Rescue Operations _____

   d) Fire Fighting Aircraft _____

   e) Fire Fighting Structural _____

   f) Fire Fighting Natural Cover _____

   g) Other (explain on back of form) _____

5. Were you exposed to fire conditions while wearing a hood equipped with:

a) Standard Facepiece	Yes ____	No ____
b) Experimental Facepiece	Yes ____	No ____

6. On the average how many hours did you use a facepiece before it had to be replaced:	Standard _____hrs	Experimental _____hrs

7. What conditions contributed most to each facepiece's failure requiring its replacement? (Note all that apply)	Number of Standards	Number of Experimentals
a) Flame Contact	_____	_____
b) Heat Exposure	_____	_____
c) Water Exposure	_____	_____
d) Light Water Exposure	_____	_____
e) Other Agent Exposure: Type: _____	_____	_____

7. What conditions contributed most to each facepiece's failure requiring its replacement? (Note all that apply) (cont'd)	Number of Standards	Number of Experimentals
f) Clearing facepiece after exposure to:		
1) Water	_____	_____
2) Lightwater	_____	_____
3) Other Agent: Type: _____	_____	_____
g) Handling	_____	_____
h) Storage	_____	_____
i) Cleaning	_____	_____
j) Replacement	_____	_____
k) Other (explain on back of form)	_____	_____

8. What type of failures were experienced? (Note all that apply)	Number of Standards	Number of Experimentals
a) Blistering of Coatings	_____	_____
b) Crazing of Coatings	_____	_____
c) Marring of Coatings	_____	_____
d) Delamination of Coatings	_____	_____
e) Worn Coatings	_____	_____
f) Melting of Facepiece	_____	_____
g) Scratches	_____	_____
h) Gouges	_____	_____
i) Poor Visibility	_____	_____
j) Other (explain on back of form)	_____	_____

9. Did you clean the facepieces after use?	Yes___	No ___
a) What type?	Standard	Yes___ No___
	Experimental	Yes___ No___
	Both	Yes___ No___

10. How did you clean the facepiece?	Standard	Experimental
a) Recommended Method	Yes___ No___	Yes___ No___
b) Other (explain on back of form)	Yes___ No___	Yes___ No___

11. Did cleaning affect the lifetime of the facepieces? Yes___ No___

a) How? Standard Experimental

1) Increased Yes___ No___ Yes___ No___

2) Decreased Yes___ No___ Yes___ No___

12. Did you protect the facepieces during storage and handling? Yes___ No___

a) What type? Standard Yes___ No___

Experimental Yes___ No___

Both Yes___ No___

13. How did you protect the facepiece? Standard Experimental

a) Recommended Method Yes___ No___ Yes___ No___

b) Other (explain on back of form) Yes___ No___ Yes___ No___

14. Did protecting the facepieces during storage and handling affect the lifetime of the facepieces? Yes___ No___

a) How? Standard Experimental

1) Increased Yes___ No___ Yes___ No___

2) Decreased Yes___ No___ Yes___ No___

15. Did you have difficulty replacing the facepiece? Yes___ No___

a) What type? Standard Yes___ No___

Experimental Yes___ No___

Both Yes___ No___

16. Explain difficulty briefly: _____

_____

_____

17. Did any damage occur to the facepiece when it was being installed? Yes___ No___

a) What type? Standard Yes___ No___

Experimental Yes___ No___

Both Yes___ No___

18. Explain type of damage briefly: _____

_____

_____

		Standard	Experimental
19.	How was your visibility with the facepiece when new?		
	a) Good	Yes___ No___	Yes___ No___
	b) Marginal	Yes___ No___	Yes___ No___
	c) Poor	Yes___ No___	Yes___ No___
20.	If visibility was poor, under what conditions was this true? (check all that apply)	Standard	Experimental
	a) Daytime	Yes___ No___	Yes___ No___
	b) Dawn	Yes___ No___	Yes___ No___
	c) Dusk	Yes___ No___	Yes___ No___
	d) Nighttime	Yes___ No___	Yes___ No___
	e) Fire Exposure	Yes___ No___	Yes___ No___
	f) Other (explain on back of form)	Yes___ No___	Yes___ No___
21.	How was your visibility with the experimental facepiece as compared to the standard when new?		
	a) Better	Yes___	No___
	b) Same	Yes___	No___
	c) Worse	Yes___	No___
22.	Did your visibility degrade more rapidly with:		
	a) Standard	Yes___	No___
	b) Experimental	Yes___	No___
	c) Same	Yes___	No___
23.	How was your heat protection with the facepiece when new?	Standard	Experimental
	a) Good	Yes___ No___	Yes___ No___
	b) Marginal	Yes___ No___	Yes___ No___
	c) Poor	Yes___ No___	Yes___ No___

		Standard	Experimental
24.	If heat protection was poor, under what conditions was this true? (check all that apply)		
	a) Flame Contact	Yes___ No___	Yes___ No___
	b) Radiation	Yes___ No___	Yes___ No___
	c) Hot Air	Yes___ No___	Yes___ No___
	d) Other (explain on back of form)	Yes___ No___	Yes___ No___
25.	How was your heat protection with the experimental facepiece compared to the standard when new?		
	a) Better	Yes___	No___
	b) Same	Yes___	No___
	c) Worse	Yes___	No___
26.	Did your heat protection degrade more rapidly with:		
	a) Standard	Yes___	No___
	b) Experimental	Yes___	No___
	c) Same	Yes___	No___
27.	Considering the overall performance of each facepiece (visibility, heat protection, and durability characteristics) which type do you prefer?		
	a) Standard	Yes___	No___
	b) Experimental	Yes___	No___
	c) Either	Yes___	No___
	d) Neither	Yes___	No___

28. State your reasons for your preference briefly. _____

_____

_____

29. The following space is provided for you to made any additional comments you may have concerning the facepiece item.

_____

_____

_____

_____

_____

INITIAL DISTRIBUTION

DDC/DDA	2
Det 1 AFESC/TST	1
AUL/LSE 71-249	1
USA/MERADCOM/DRDME-GE	1
USAF/TRADOC/ATEN-FE-FP	1
HQ NAVMAT/04F	1
HQ NAVFAC/10F	1
HQ NAVFAC/103B	1
NRL/6180	1
HQ NAVAIR/53433A	1
FAA-NAFEC/ANA-420	1
NGB/DEM	1
AFRES/DEMF	1
HQ PACAF/DEMF	1
HQ TAC/DEMF	1
HQ USAFE/DEMF	1
HQ USCG/G-MT-4/82	1
HQ USCG/ENE 5-B	1
USCG R&C CTR/Avery Point	1
HQ MAC/DEMF	1
HQ AAC/DEMF	1
HQ AFSC/DEMF	1
HQ SAC/DEMF	1
HQ ATC/DEMF	1
HQ ADCOM/DEMF	1
HQ AFLC/DEMF	1
W-R ALC/MMIRAB	1
AFETO/DOZ	1
Det 1 AFESC/CNS	5
3340 TTG/TTMF	1
NFPCA	1
HQ AFSC/SDAE	1
FAA/AAP-720	1
HQ NAVSEA/04H6	1
NAVSEC/6154F	1
NCTRF	50
Det 1, Hq ADTC/PRT	1

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